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Child emotional dysregulation paths for self-injurious behaviour engagement in adolescence

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Abstract

Objectives. To identify the heterogeneous trajectories of emotional dysregulation across childhood, and to determine the relationship between specific trajectories and self-injurious behaviour (SIB) engagement in adolescence. **Methods.** Data from the Millennium Cohort Study (N=13,853 British children; 49.07% female, *M* = 3.13 years at baseline, *SD* = 0.2) was used to identify the heterogeneous trajectories of emotional dysregulation from 3 to 8 years old. Moreover, 1,992 participants (52.86% female) from the initial sample was used to study the relationship between child emotional dysregulation trajectory membership and engagement in both non-suicidal SIB and suicide attempt at age 17. Other time-invariant and proximal (adolescent) risk factors were incorporated into analysis. **Results.** Six trajectories of emotional dysregulation were identified. Trajectory membership was not associated with 12-month non-suicidal SIB engagement in adolescence, but the history of non-suicidal self-harm and other proximal risk factors. Child trajectories featured by earlier emotional dysregulation were associated with higher risk of lifetime suicide attempt, as well as proximal risk factors such as non-suicidal self-harm. **Conclusion.** This study found differential risk profiles involved in both SIB forms. While early emotional dysregulation may boost suicide attempt engagement in adolescence, it had no impact on the development of non-suicidal self-harm.

Key words: Child emotional regulation; Self-injurious behaviour; Non-suicidal self-harm; Suicide Attempt; Adolescence.

Child emotional dysregulation paths for self-injurious behaviour engagement in adolescence

Self-injurious behaviour (SIB) comprises a variety of acts aimed at hurting oneself either with or without suicidal intent [1]. Two main forms of SIB can be conceptualised due to their distinctive functions, and specific underpinnings [2–5]: non-suicidal SIB and attempted suicide (i.e., SIB with suicidal intent). In this regard, non-suicidal self-injury constitutes a maladaptive coping strategy to deal with difficult and negative emotions. Attempted suicide involves purposeful self-inflicting injury with the intent to die.

Prevalence rates of adolescent SIB have significantly increased in recent years [6, 7], with one in five adolescents had been reported to engage in non-suicidal SIB every year [8]. In addition, self-harm repetition has a incidence peak in late adolescence [9–11]. On the other hand, suicide constitutes the fourth leading cause of death in adolescents aged 15-19 years [12]. Suicidal attempt constitutes one of the key risk factors for suicide mortality [13].

Although SIB may serve as a "gateway" to suicidal attempt [14, 15], the presence of childhood risk factors including traumatic events and early adversities (e.g., child maltreatment, insecure family environments, economic hassles) can play a critical role in the engagement and repetition of SIB acts in adolescence [16, 17]. Previous studies have suggested that the impact of early adversities may be mediated by the way the individuals cope with overwhelming emotional states and mood (i.e., emotional regulation [18–21]). Emotional regulation skills (i.e., those involved in processes of monitoring, evaluation, and modification of emotional reactions) are developed throughout childhood, initially coming from the interaction with parents and caregivers.

During preschool years, children have already show a wide repertoire of behavioural and cognitive strategies to manage their positive and negative emotions which tend to become more sophisticated with age, in parallel with prefrontal cortex development (involved in executive function and overall cognitive performance) [22–24].

Deficits in emotional regulation skills throughout childhood have been linked with the emergence of numerous mental disorders in adolescence, such as depression, anxiety and substance use disorder, and with low academic performance and SIB [20, 21, 25–27]. However, longitudinal studies that focused on identifying specific emotional dysregulation paths are scarce. This paucity of studies may hinder the identification of vulnerable adolescents at higher risk for SIB engagement. The course of maladaptive emotional regulation in childhood may also boost the influence of proximal risk factors on adolescent SIB, such as bullying exposure, substance use and psychopathological symptoms [10, 23, 28–30]. This study aimed to identify the heterogeneous trajectories of emotional dysregulation throughout childhood. Another aim of this study was to longitudinally investigate the role of child emotional dysregulation trajectory and proximal (adolescent) risk factors in non-suicidal self-injurious behaviour and suicide attempt in late adolescence.

Method

Sample and study variables

Longitudinal data from the Millennium Cohort Study (MCS; Connelly & Platt, 2014) were used in this study. More concretely, data from 13853 toddlers were used (51.24% boys; mean age at baseline = 3.13 years, *SD* = 0.20). The Millennium Cohort Study is a UK nationally-representative birth cohort study aimed at depicting the developmental course of physical and mental health outcomes of people born between 2000-2002 (millennials), and focused specifically in the identification of potential

socioeconomic and health-related protective and risk factors. Data from people living in the four United Kingdom countries were collected in the MCS. Sampling was based on a stratified clustering strategy to ensure adequate representation of ethnic minorities. All the protocols conducted in the MCS was approved by an ethical committee for human research [32].

We used data from parents' reports from three MCS sweeps: MCS 2004 sweep (n = 12907; cohort member age, m = 3.13, sd = 0.20), considered the baseline wave in this study; 2006 sweep (n = 13853; cohort member age, m = 5.22, sd = 0.25) and 2008 sweep (n = 12462; cohort member age, m = 7.23, sd = 0.25). More concretely, sociodemographic data (i.e., child's sex, ethnic group, household income) at baseline were used. Moreover, responses to the 5-item emotional dysregulation scale of the Child Social Behaviour Questionnaire (CSBQ)[33, 34] across the three aforementioned sweeps were used. This score accounts for child's emotional dysregulation (i.e., reactivity and recovery from negative emotions: frequency of mood swings, over excitation, frustration and impulsiveness), pointing to higher scores with higher emotional dysregulation.

Adolescent variables included self-reported data collected when cohort member was adolescent. More concretely, data from the MCS 2015 sweep (n = 9791; 50.50% female; cohort member age, m = 13.77, sd = 0.45) and MCS 2018 sweep (n = 8586; 50.93% female; cohort member age, m = 17.17, sd = 0.33) were used. For this purpose, two items were taken from the MCS 2015 sweep that included history of bullying (item: 'How often other children hurt or pick on cohort member?') and self-harm in mid adolescence (whether the cohort member had self-hurt in the last year at least in one of these self-harm modalities: bruising or pinching themself; burning yourself; cutting or stabbing, taking an overdose of tablets, pulled out hair). Finally, proximal adolescent

factors were measured at the MCS 2018 sweep: current mental health difficulties, derived from the Strength and Difficulties Questionnaire (SDQ)[35] total score. Moreover, a cognition score, derived from the from the 10-item version of the Cognitive Abilities Test 3, Level H, Number Analogies test [36, 37] was used. The higher the score, the better the cognitive performance inferred. Finally, alcohol drinking, cannabis smoking and other drug use taking data were used from the 2018 sweep.

The adolescent outcomes were also measured at MCS 2018 Sweep: 12-month non-suicidal self-harm (whether the cohort member had self-hurt in the last year at least in one of these ways: bruising or pinching themself; burning yourself; cutting or stabbing, taking an overdose of tablets, pulled out hair) and adolescent suicide attempt (item: 'Have you ever hurt yourself on purpose in an attempt to end your life?').

Data analysis

Attrition analysis was conducted by comparing the sample used for emotional regulation trajectory enumeration (N = 13853) and the adolescent sample with complete data (n = 1992), by means of the Pearson's χ^2 test for independent samples (for binary or categorical factors) and the t test (continuous factors). To prevent from type I error inflation, meaningful differences (i.e., those with at least medium effect size: Cramer's $V \geq .30$ or Cohen's $d \geq .50$) were indicative of sample differences due to the large sample size in analysis [38].

Growth mixture modelling (GMM) [39, 40] was used to identify heterogeneous trajectories of emotional dysregulation (CSBQ score) throughout the childhood (from 3 to 8 years old). GMM constitutes a flexible person-centred approach that allows for latent trajectory identification, as the assumption of a unitary course of development is relaxed. Subject-specific variability may be well captured by clustering individuals with similar developmental course into a same group (class). Model estimation relies on

robust maximum likelihood and full information methods (this enables the depiction of individual-specific trajectories even when intermittent missing data are present). To model the longitudinal course of emotional dysregulation, age was used as a time factor (considering both a linear and quadratic effect on trajectory) and no covariate was included into models to prevent from increased probability of class overestimation [41, 42].

Following a model comparison rationale, GMM solutions with increasing trajectory classes were tested. Criteria to select the model with the optimal class enumeration were: low sample-adjusted Bayesian information criterion (SABIC) and Akaike information criterion (AIC), mean of posterior probabilities to belong to each identified class higher than .70; and meaningful proportion of participants within each class (5%).

Binary logistic regression was used to study the risk of showing non-suicidal self-harm and suicide attempt at age 17 separately, by means of time-invariant (i.e., sex and ethnic group), distal (child emotional dysregulation class membership), mid-adolescence (bullying exposure at age 14) and proximal (adolescent) risk factors (i.e., household income, mental health difficulties, cognition score, alcohol, cannabis and other drug use at age 17). The history of non-suicidal self-harm (i.e., non-suicidal self-harm in mid-adolescence) was used as a risk factor to explain the non-suicidal outcome at age 17. The 12-month non-suicidal self-harm at age 17 was used as a covariate for adolescent suicide attempt. The UK country was used as a weighting factor. The AIC was estimated to assess whether the model with covariates fitted better than an unconstrained model. The McFadden's adjusted pseudo-R^2 was used as an effect size estimate. The odds ratio (*OR*) was used as a covariate loading estimate.

All the analyses were conducted by means of R x64 3.0.1 (lcmm and psych packages).

Results

The Table 1 displays the descriptive statistics of sample used to identify the emotional dysregulation trajectories (baseline sample) and the sample for outcome prediction (adolescent sample), as well as the attrition analysis. Although significant differences were found between samples, none of them reached the level of meaningfulness (i.e., at least medium effect size). Of note was the finding that more 27% of adolescents (considering the complete-case sample) had engaged in non-suicidal self-harm in the last year when they were 17 years old. Furthermore, 7.93% of the adolescents had attempted suicide.

(Insert Table 1 here)

Analysis on emotional dysregulation trajectory identification pointed to a better fit of the 6-class model depicting a quadratic effects of time (SABIC = 24721.33, AIC = 24612.37; mean of posterior probabilities for each class = .87 - .97). Fit indexes derived from all the estimated GMM solutions are displayed in Table S1 (see the Supplementary material). The course of emotional dysregulation across the identified class is plotted in Figure 1. The first class (U-shaped class; 15.25% of participants) was featured by decreasing emotional dysregulation in early ages, leveling off at age 6 (linear effect of age with slope, $B = -0.67$, $p < .01$; quadratic slope, $B = 0.23$, $p < .01$), and showed an increase thereafter. The second class (decreasing dysregulation class) comprised 22.51% of participants and was characterized by a decreasing trajectory of emotional dysregulation over time (linear effect of age with slope, $B = -5.14$, $p < .01$; quadratic

slope, $B = 0.93$, $p < .01$). The third class (increasing dysregulation class) was characterized by an rise of emotional dysregulation over time (linear effect of age with slope, $B = 0.41$, $p < .01$; quadratic slope, $B = -0.15$, $p < .01$); this class comprised 10.94% of the participants. The fourth class (heightened dysregulation class; 10.58% of participants) showed heightened emotional dysregulation over time with a slight increase from age 6 onwards (linear effect of age, $B = -1.59$, $p < .01$; quadratic slope, $B = 0.55$, $p < .01$). The fifth class (normative class; 32.34% of participants) showed minimal levels of emotional dysregulation up to age 6, with a slightly increasing pattern onwards (linear effect of age, $B = -0.50$, $p < .01$; quadratic slope, $B = 0.17$, $p < .01$). The final class (inverted U-shaped class; 8.39% of participants) was featured by increasing levels of emotional dysregulation up to age 6, then showed a decreasing pattern of emotional dysregulation thereafter (linear effect of age with slope, $B = 4.21$, $p < .01$; quadratic slope, $B = -0.60$, $p < .01$). The Table S2 (see Supplementary material) displays the profile factors related to each identified classes in comparison to the normative class.

(Insert Figure 1 here)

Regarding adolescent outcome prediction, logistic regression modelling revealed that the covariates studied were relevant to explain both outcomes at age 17, as model with covariates showed lower AIC (for the 12-month self-harm behaviour outcome, AIC = 5593.18; for the suicide attempt outcome, AIC = 2325.41) than the unconstrained one (for the 12-month self-harm behaviour outcome, AIC = 15185.81; for the suicide attempt outcome, AIC = 7545.38). The models with covariates explained a significant proportion of outcome variance, for both the 12-month non-suicidal self-harm outcome

(pseudo-R^2_{adj} = .21) and suicide attempt outcome (pseudo-R^2_{adj} = .26). The Table 2 displays the covariate coefficients according to outcome.

Child emotional dysregulation class membership (in comparison to the normative class) was associated with an increased risk of having engaged in suicide attempt but not in non-suicidal self-harm in the last year. More concretely, adolescents who were at higher risk of having attempted suicide were more likely to show either a decreasing emotional dysregulation trajectory in childhood (OR = 1.93, $p < .01$), heightened dysregulation trajectory (OR = 2.06, $p < .01$) or a U-shaped trajectory (OR = 1.48, $p < .01$).

The risk of showing non-suicidal self-harm behaviour in the last year was associated with being female, middle household income quartiles, mental health difficulties, higher cognitive score, cannabis use and mid-adolescence non-suicidal self-harm and bullying. Adolescent suicide attempt risk (regardless of their emotional dysregulation trajectory membership) was related to being female, from Asian ethnic groups, lower household income, lower cognitive score and lower levels of alcohol drinking. Finally, suicide attempt was associated with higher levels of mental health difficulties, marijuana use and concurrent non-suicidal self-harm and bullying in mid adolescence.

(Insert Table 2 here)

Discussion

This study aimed to gain insight into the specific paths of child emotional dysregulation that may lead to SIB engagement in adolescence. The two main SIB forms examined were non-suicidal SIB and suicide attempt. Our study revealed the

presence of six trajectories of emotional dysregulation with different courses across childhood. Three of these trajectories (i.e., decreasing emotional dysregulation trajectory, heightened dysregulation trajectory, and U-shaped trajectory) were associated with an increased risk of adolescent suicide attempt. Being girl and some proximal (i.e., lower socioeconomic status, mental health difficulties, cannabis use, cognitive performance and 12-month self-harm) and mid-adolescence risk factors (i.e., bullying exposure) were also associated with suicide attempt.

Conversely, none of the emotional dysregulation trajectories was significantly associated with non-suicidal SIB in late adolescence, except for sex and proximal risk factors. In this regard, the history of non-suicidal self-harm (i.e., non-suicidal self-harm in mid adolescence) was proven to be highly influential for subsequent non-suicidal SIB, in line with existing evidence on increased non-suicidal self-harm repetition risk in late adolescence [9, 10].

Our results support the hypothesis of differential mechanisms and motivational components in the two forms of SIB (non-suicidal SIB and suicide attempt). May and Klonsky [5] developed a 2-factor model to explain SIB motivation. In this sense, intrapersonal (i.e., internal, self-oriented) and interpersonal (i.e., other-oriented) motives may dynamically interact to put individuals at higher risk of SIB engagement. The intrapersonal motives include affect regulation, anti-suicide reasons (i.e., coping strategy for resisting urges to attempt suicide) and self-punishment. Intrapersonal motives have been associated with non-suicidal SIB repetition [43]. As reported by numerous research, the most common motives to engage in non-suicidal SIB are intrapersonal: psychological pain and coping strategy [43, 44].

Our result indicated that approximately one in four adolescents (27.8%) had engaged in non-suicidal SIB in the last 12 months. Bearing in mind the May and

Klonky's framework, it is not surprising to see that the proximal factors were strongly associated with non-suicidal self-injury engagement. In this sense, adolescents with higher mental health difficulties were at higher risk of non-suicidal SIB; speculatively, non-suicidal SIB was used to cope with the negative emotions associated with these mental health difficulties. Moreover, the high use of cannabis may be considered as another maladaptive coping strategy in that it is used to manage symptoms of mental health difficulties (i.e., self-medication) [45, 46]. In line with previous studies [47, 48], being a girl and part of a family from low-to-middle socioeconomic backgrounds, as well as the history of bullying have also been associated with non-suicidal SIB. Finally, we found a higher risk of engaging in non-suicidal SIB with higher cognition score. Note that the cognition score used in this study is related with fluid intelligence skills [36, 37]. In this regard, the relationship with SIB risk may be mediated by other cognitive moderators not included in this study, such as perfectionism, which is highly related to high intellectual quotient and elevated cognitive performance [49, 50].

The risk of adolescent suicide attempt was associated with some proximal risk factors related to maladaptive coping (i.e., mental health difficulties, cannabis use and bullying history). For that reason and in line with previous studies [5, 51], suicide attempt may be also driven by coping-specific motives, as non-suicidal SIB may. However, other intrapersonal (i.e., escape, hopelessness) and interpersonal motives (i.e., suicide as a method of communication, help seeking) have also been consistently associated with suicide attempt in adolescence [52, 53]. Suicide behaviour may be driven by the desire to escape from feelings of entrapment (due to highly intense emotions), in conjunction with cognitive (e.g., thwarted belongingness, perceived burdensomeness and psychological pain) and volitional moderators (e.g., having access to the means of suicide, acquired capability to attempt suicide, impulsivity) [2, 54].

Indeed, in support of this argument, we found concurrent non-suicidal SIB to be the covariate with a stronger relationship with suicide attempt (*OR* = 7.84). Non-suicidal SIB engagement could be related with an increased capability to attempt suicide, due to repeated exposure to pain.

Regarding emotional dysregulation trajectories, we found that trajectories sharing higher dysregulation scores at earlier age (i.e., decreasing emotional dysregulation trajectory, heightened dysregulation trajectory, and U-shaped trajectory) to have placed the individuals at higher risk of suicide attempt in adolescence. Moreover, adolescents showing these trajectories were characterised by some distinctive features at an earlier age (see Table S2 in the Supplementary material): coming from lower-income backgrounds, showing higher levels of psychological symptoms and having parents with higher levels of psychopathology. Emotional regulation skills tend to become more stable during preschool age. Unfortunately, emotional insecurity due to ambivalent bonding, poverty, interparental conflict and parental psychopathology may significantly contribute to increased emotional regulation deficits across early childhood [55, 56].

Early emotional regulation deficits may lead to increasing difficulties when dealing with intense emotions across childhood, contributing to maladaptive emotional cascade development (i.e., escalation in negative emotion intensity due to vicious cycles of interactions between maladaptive coping strategies, such as rumination, and negative affect). Maladaptive emotional cascades constitute critical precursors of emotional instability and personality disorder development in adolescence [57, 58]. Suicide may therefore be seen as an effective way to escape from negative thoughts about one’s self and emotional pain, derived from negative emotional cascades.

On the other hand, our results go in line with existing studies pointing to increased risk of suicide attempt in adolescent females, lower-income backgrounds and poorer cognitive performance (i.e., associated with poorer problem-solving skills and impulsivity) [6, 11, 59]. It may be of particular interest the negative relationship between alcohol drinking and risk of suicide attempt. Even though, it should be considered that alcohol use may be a mean to satisfactorily achieve social motives to build social camaraderie in adolescence [60].

This study provides some interesting evidence on the relevance of tackling adolescent SIB. First, we found that more than one in four adolescents had engaged in non-suicidal self-harm in the last year when they were 17 years old. In this regard, adolescent non-suicidal SIB may be seen as a coping strategy to deal with negative emotions at a short-term. For that reason, proximal factors (e.g., adolescent's psychopathology) may be more relevant to explain non-suicidal self-harm behaviour. Regarding adolescent suicide attempt, almost 8% of adolescents had committed at least one suicide attempt in their entire life. Distal factors (i.e., the course of emotional dysregulation in preschool age) may constitute a risk factor for key mediators of suicidal self-injury, such as maladaptive emotional cascades, impulsivity and emotional instability. The findings presented in this study come from a robust analytical strategy using longitudinal data from a large cohort of adolescents followed from early life. Moreover, some relevant proximal and distal factors were included in the analysis.

Some limitations deserve being mentioned. First, the SIB forms were measured at different time scales (i.e., 12-month non-suicidal SIB and lifetime suicide attempt). This issue is related to the MCS design considering two obvious reasons: first, the lower prevalence of suicide attempt in comparison to non-suicidal SIB in community samples; and second, the critical relationship between an episode of suicide in adolescence and

the poorer mental health outcome later in life [14, 15, 61]. On the other hand, the sample for adolescent SIB analysis was much smaller than baseline sample. In other words, attrition rate was substantially large between samples. Despite a long follow-up period (14 years), adolescent sample in analysis did not show meaningful differences comparing to baseline sample, in terms of sociodemographic and clinical factors (see Table 1). Finally, our results provide an overall, community-based picture on the relationship between emotional dysregulation trajectory in childhood and adolescent SIB. In this regard, multi-informant data were not collected across study waves. In addition, relevant risk factors and SIB contributors (e.g., mental disorder diagnosis, psychological or psychiatric treatment, maladaptive emotional cascade, distress intolerance) are missing from this study. Further research should contribute to disentangle specific paths of adolescent development using a more fine-grained approach at a clinical level with a multi-informant data collection procedure.

Some clinical implications may be derived from this study. First, a lifelong perspective should be followed to identify individuals at risk of suicide behaviour in adolescence. Some studies have identified a substantial proportion of individuals engaging in suicidal SIB without any apparent risk factor [20]. A lifelong perspective may contribute to accurately detect at-risk profiles from earlier in life. Second, preventive action become mandatory. Selective intervention should be provided for toddlers with poorer emotional regulation skills. Third, this study aims at promoting awareness of children’s mental health issues. The promotion of children's emotional and behavioural wellbeing should be prioritised towards an overall healthy development. Finally, a call for action is made to tackle SIB during the post COVID-19 pandemic in terms of prevention policy and child mental health promotion.

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Table 1. Descriptive statistics and attrition analysis.

	Trajectory enumeration sample (N = 13,853)	Adolescent sample (n = 1,992)	Attrition analysis	
			Contrast test	ES
Sex (% female)	49.07	52.86	14.12	0.03
Ethnic group			192.44	0.07
White	87.9	97.14		
Asian	7.23	1.26		
Black	2.65	0.6		
Other/Mixed	2.22	1		
Country			19.27	0.02
England	62.31	59.09		
Wales	15.31	17.62		
Scotland	12.3	13.96		
North Ireland	10.08	9.34		
Baseline variables				
Age (years)	3.13 (0.2)	3.11 (0.17)	4.69	0.1
Household income[1]			363.3	0.1
1st quintile	20.27	9.36		
2nd quintile	20.31	14.39		
3rd quintile	19.96	19.87		
4th quintile	19.81	25.91		
5th quintile	19.65	30.48		
Adolescent (proximal) variables				
Mental health difficulties[2]	11.25 (5.56)	11.17 (5.46)	0.72^{ns}	0.02
Cognition score[3]	5.28 (2.69)	5.75 (2.61)	-8.94	-0.23
Alcohol drinking in the last year (% >40 times a year)	11.11	12.1	2.61^{ns}	0.01
Cannabis smoking in the last year			218.97	0.08
No use	74.13	63.81		
Sporadic	17.91	29.02		
Regular	7.97	7.18		
Other drug use in the last year (%yes)	3.88	6.48	45.09	0.04
History of bullying (%yes)[4]	15.35	17.06	5.2	0.01
History of non-suicidal self-harm behaviour (%yes)[5]	14.98	17.84	15.08	0.02
12-month non-suicidal self-harm behaviour (%yes)	23.25	27.81	30.05	0.03
Lifetime suicide attempt (%yes)	7.45	7.93	0.77 ^{ns}	0

Note. Percentage of cases are displayed for dichotomous and categorical variables. Mean and standard deviation (between brackets) are displayed for continuous variables. Attrition analysis involves comparing the variables of interest between the sample used to enumerate emotional regulation trajectories and the adolescent sample. The t -based tests (continuous variables) and χ^2 tests (dichotomous/categorical variables) were used as contrast test statistics. Effect size (ES) estimates were the Cohen's d for continuous variables and Cramer's V for non-continuous ones.

[1] Quintiles were calculated from the Organisation for Economic Co-operation and Development data, using the whole Millennium Cohort Study sample (N = 18,552); [2] Derived from the Strength and Difficulties Questionnaire total score; [3] Total score from the Cognitive Abilities Test 3, Level H, Number Analogies

test. [4] Self-reported items on being bullied at age 14 (2015). [5] Non-suicidal self-harm behaviour at age 14 (2015).
All contrast tests were significant ($p < .05$), except those with superscript [ns].

Table 2. Predictors of 12-month self-harm behaviour and lifetime suicide (*n* = 1,992).

	Non-suicidal self-harm		Suicide attempt	
	OR (CI_{95})	*z*	*OR* (CI_{95})	*z*
(Intercept)	0.11 (0.09, 0.13)	-21.98**	0.01 (0.01, 0.01)	-24.1**
Sex (ref. Male)				
Female	1.89 (1.64, 2.19)	8.58**	1.79 (1.4, 2.31)	4.53**
Age	0.92 (0.86, 0.99)	-2.15*	0.96 (0.86, 1.08)	-0.67
Ethnic group (ref. White)				
Asian	1.06 (0.55, 1.97)	0.19	2.57 (1.04, 5.68)	2.2*
Black	0.76 (0.33, 1.57)	-0.69	0.38 (0.02, 1.93)	-0.92
Other/mixed	0.7 (0.35, 1.34)	-1.04	0.71 (0.16, 2.18)	-0.54
Household income (ref. 1st quartile)				
2nd quartile	1.22 (1.03, 1.43)	2.34*	0.85 (0.66, 1.1)	-1.2
3rd quartile	1.96 (1.31, 2.9)	3.33**	0.43 (0.18, 0.92)	-2.03*
4th quartile	1.18 (0.98, 1.41)	1.79	0.61 (0.45, 0.83)	-3.17**
Mental health difficulties[1]	2.6 (2.41, 2.81)	24.33**	1.62 (1.44, 1.83)	7.83**
Cognition score[2]	1.17 (1.09, 1.26)	4.38**	0.78 (0.69, 0.88)	-3.97**
Alcohol drinking (ref. Less than 40 times a year)	1.22 (0.98, 1.51)	1.77	0.66 (0.44, 0.95)	-2.16*
Cannabis smoking (ref. No use)				
Sporadic use	1.4 (1.19, 1.65)	4.03**	1.67 (1.29, 2.17)	3.87**
Regular use	1.52 (1.12, 2.04)	2.74**	2.54 (1.68, 3.82)	4.45**
Other drug use (ref. No)	1.28 (0.94, 1.73)	1.6	1.37 (0.88, 2.09)	1.43
Self-harm behaviour at age 14 (ref. No)	3.54 (3, 4.19)	14.8**		
Self-harm behaviour at age 17 (ref. No)			7.84 (6.07, 10.21)	15.53**
Bullying history[3]	1.22 (1.03, 1.45)	2.3*	1.9 (1.49, 2.42)	5.21**
Emotional dysregulation class (ref. Normative)				
Decreasing	1.03 (0.86, 1.23)	0.32	1.93 (1.43, 2.6)	4.28**
Increasing	0.96 (0.75, 1.22)	-0.35	1.25 (0.82, 1.88)	1.04
Heightened	0.82 (0.65, 1.02)	-1.79	2.06 (1.44, 2.94)	3.99**
U-shaped	0.95 (0.74, 1.21)	-0.43	1.48 (1.01, 2.17)	2.02*
Inverted U-shaped	0.91 (0.7, 1.19)	-0.67	1.07 (0.67, 1.66)	0.29

Note. Logistic binary regression was used for both the self-harm behaviour and suicide outcomes (reference category: absence). UK country was used as a weighting factor in the regression.
OR = Odds ratio. CI_{95} = 95% confidence interval of the *OR*. *z* = Wald's *z*-based statistic to test whether loading is significantly different from one.

[1] Total score of the Strengths and Difficulties Questionnaire.

[2] Total score from the Cognitive Abilities Test 3, Level H, Number Analogies test.

[3] Taken from the self-reported question on being bullied at age 14.

* $p < .05$; ** $p < .01$.

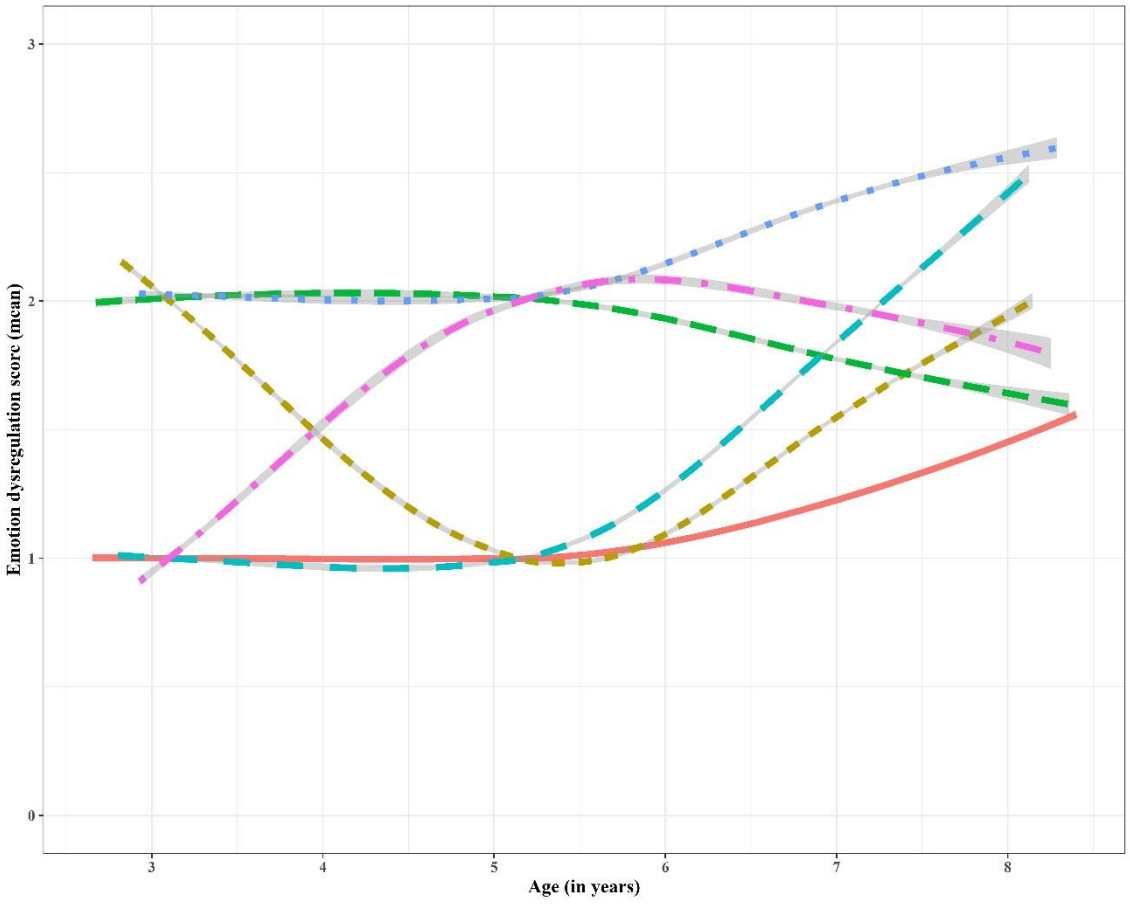

Figure 1. Heterogeneous trajectories of emotion dysregulation in childhood.
Note. Emotion dysregulation was measured by parent' response to the Child Social Behaviour Questionnaire (CSBQ).
Shaded area displays the 95% confidence interval of the mean.
Trajectory classes: Modal class = Orange solid line. U-shaped class = Olive green line.
Decreasing dysregulation class = Green dashed line. Increasing dysregulation class = Turquoise dashed line.
Heightened dysregulation class = Blue dotted line. Inverted U-shaped class = Violet dashdot line.

Supplementary material

Results

The Table S2 displays the profile factors related to each identified classes in comparison to the normative class; profile factors were measured at the baseline (i.e., MCS 2004 sweep). Findings were based on multinomial logistic regression analysis, considering the normative emotion dysregulation trajectory class membership as an outcome reference class. The UK country was used as a weighting factor in this analysis. As a result, the regression model showed a McFadden's pseudo-R^2 = .10, and AIC = 57975.26 (AIC for the unconstrained model = 72861.32). Children showing the U-shaped trajectory were more likely to be male, living in a rural area, with lower levels of household income and parents less educated. Finally, they were featured by poorer physical and mental health, and poorer sleep routines and child-parent relationships. Although members of the decreasing trajectory class showed a relatively similar profile than the U-shaped trajectory children, they were also featured by a higher risk of living without any of their natural parents. The heightened emotion dysregulation trajectory children were also featured by the same risk factors, but coefficients pointed to stronger relationships with class membership. The increasing emotion dysregulation trajectory was less characteristic of children from Asian ethnic groups in comparison to normative trajectory children. Finally, the inverted U-shaped trajectory members could live either in rural or urban areas. Even though the same risk factors that featured the other non-normative classes were significantly linked with the inverted U-shaped trajectory membership.

Table S1. Growth mixture modelling solutions for emotion dysregulation course.

Class	Model specification	Emotional dysregulation			
		LL	AIC	SABIC	%n in class
1	intercept	-27292.54	54591.08	54604.15	100
1	linear	-26428.09	52864.18	52881.61	100
1	quadratic	-24665.38	49340.77	49362.56	100
2	intercept	-26246.26	52502.52	52524.32	35.75-64.25
2	linear	-25334.94	50683.87	50714.38	35.22-64.78
2	quadratic	-24237.05	48492.11	48531.33	21.32-78.68
3	intercept	-26246.26	52506.52	52537.03	0-63.60
3	linear	-24738.62	49497.23	49540.82	21.09-48.36
3	quadratic	-19769.61	39565.23	39621.89	22.72-44.87
4	intercept	No convergence			
4	linear	-24738.62	49503.23	49559.89	4.58-82.13
4	quadratic	-18992.33	38018.66	38092.75	7.76-44.55
5	intercept	No convergence			
5	linear	-24309.20	48650.40	48720.14	0-43.25
5	quadratic	-14673.32	29388.64	29480.16	8.94-33.62
6	intercept	No convergence			
6	linear	-24309.20	48656.40	48739.21	0-59.11
6	quadratic	-12281.18	24612.37	24721.33	8.39-32.34

Note. All solutions were modelled using age (centred on the minimum) as a time factor, with no effect (intercept model) linear or quadratic effects (see Model specification).

'Class' refers to number of classes considered in each model. '%n in class' refers to percentage of participants in each class.

LL = Maximum log-likelihood estimator for model convergence; AIC = Akaike information criterion; SABIC = Sample-adjusted Bayesian information criterion.

Table S2. **Regression coefficients to explain emotion dysregulation class membership.**

	U-shaped		Decreasing		Increasing		Heightened		Inverted U-shaped	
	RRR (*CI*$_{95}$)	*Z*	*RRR* (*CI*$_{95}$)	*Z*	*RRR* (*CI*$_{95}$)	*Z*	*RRR* (*CI*$_{95}$)	*Z*	*RRR* (*CI*$_{95}$)	*Z*
Sex (ref. Boy)										
Girl	0.84 (0.78, 0.91)	-4.18**	0.93 (0.83, 1.04)	-1.31	0.88 (0.79, 0.97)	-2.54*	0.58 (0.52, 0.64)	-10.19**	0.71 (0.64, 0.80)	-5.90**
Urbanicity (ref. Urban)										
Rural	0.87 (0.80, 0.95)	-3.20**	0.78 (0.70, 0.87)	-4.35**	0.95 (0.85, 1.05)	-1.01	0.75 (0.67, 0.83)	-5.25**	0.92 (0.82, 1.03)	-1.46
Ethnic group (ref. White)										
Asian	1.18 (0.91, 1.53)	1.28	1.32 (0.97, 1.80)	1.74	0.57 (0.38, 0.86)	-2.70**	0.89 (0.64, 1.22)	-0.74	1.33 (0.97, 1.83)	1.74
Black	0.78 (0.55, 1.11)	-1.39	0.63 (0.39, 1.04)	-1.81	0.62 (0.38, 1.01)	-1.91	0.72 (0.46, 1.13)	-1.41	0.81 (0.51, 1.30)	-0.87
Other/mixed	0.82 (0.56, 1.21)	-0.99	0.97 (0.60, 1.56)	-0.14	0.62 (0.36, 1.07)	-1.71	0.72 (0.44, 1.18)	-1.29	1.12 (0.70, 1.80)	0.47
Household income (ref. 1st quintile)[1]										
2nd quintile	0.90 (0.78, 1.04)	-1.44	0.77 (0.65, 0.92)	-2.84**	0.85 (0.70, 1.02)	-1.73	0.76 (0.65, 0.90)	-3.20**	0.74 (0.62, 0.89)	-3.26**
3rd quintile	0.77 (0.66, 0.89)	-3.51**	0.67 (0.56, 0.81)	-4.13**	0.86 (0.71, 1.03)	-1.61	0.50 (0.42, 0.60)	-7.59**	0.52 (0.43, 0.63)	-6.56**
4th quintile	0.67 (0.57, 0.78)	-5.18**	0.63 (0.51, 0.76)	-4.68**	0.72 (0.60, 0.88)	-3.22**	0.37 (0.30, 0.45)	-10.11**	0.43 (0.35, 0.53)	-8.1**
5th quintile	0.59 (0.50, 0.69)	-6.38**	0.46 (0.37, 0.58)	-7.02**	0.63 (0.52, 0.78)	-4.37**	0.31 (0.25, 0.39)	-10.91**	0.35 (0.28, 0.43)	-9.54**
Living with both natural parents (ref. yes)										
No	1.12 (0.98, 1.27)	1.71	1.34 (1.15, 1.57)	3.68**	1.01 (0.86, 1.19)	0.14	1.19 (1.03, 1.39)	2.32*	1.14 (0.96, 1.34)	1.51
Parents' education (years)[2]	0.92 (0.91, 0.94)	-8.71**	0.90 (0.87, 0.92)	-8.94**	0.97 (0.95, 0.99)	-2.68**	0.87 (0.85, 0.89)	-11.29**	0.97 (0.95, 0.99)	-2.44*
Parental psychopathology[2,3]	1.03 (1.01, 1.04)	3.82**	1.04 (1.02, 1.06)	4.86**	1.01 (0.99, 1.03)	1.12	1.05 (1.03, 1.07)	6.24**	1.02 (1.00, 1.04)	2.27*
Toddler's health status (ref. good)										
Poor	1.17 (1.04, 1.32)	2.53*	1.24 (1.07, 1.44)	2.85**	1.05 (0.90, 1.23)	0.66	1.38 (1.19, 1.58)	4.42**	1.59 (1.37, 1.86)	6.04**
Toddler's development[4]	0.99 (0.97, 1.00)	-1.37	1.00 (0.98, 1.02)	0.23	1.01 (0.99, 1.03)	0.64	1.02 (1.00, 1.04)	1.98*	1.01 (0.99, 1.04)	1.37
Eating routines (ref. usually not followed)										

Sometimes	1.07	(0.73,	0.36	1.08	(0.67,	0.30	1.17	(0.68,	0.56	0.70	(0.47,	-1.7	1.08	(0.66,	0.29
	1.58)			1.74)			2.00)			1.06)			1.76)		
Always	1.02	(0.69,	0.12	1.09	(0.67,	0.36	1.15	(0.67,	0.5	0.60	(0.39,	-2.44*	0.91	(0.55,	-0.38
	1.51)			1.77)			1.97)			0.90)			1.50)		
Sleep routines (ref. usually not followed)															
Sometimes	0.57	(0.48,	-6.12**	0.70	(0.56,	-3.07**	0.84	(0.66,	-1.4	0.62	(0.50,	-4.46**	0.54	(0.43,	-5.30**
	0.69)			0.88)			1.07)			0.77)			0.68)		
Always	0.55	(0.46,	-6.34**	0.61	(0.48,	-4.17**	0.77	(0.60,	-2.05**	0.58	(0.47,	-4.84**	0.58	(0.46,	-4.62**
	0.66)			0.77)			0.99)			0.73)			0.73)		
Child-parent relationship[5]	0.86	(0.85,	-38.61**	0.82	(0.81,	-40.58**	0.91	(0.91,	-17.84**	0.78	(0.77,	-52.25**	0.90	(0.89,	-20.91**
	0.86)			0.83)			0.92)			0.79)			0.90)		

Note. Multinomial logistic regression was conducted to explain emotional dysregulation class membership. Reference category for the outcome was the normative trajectory class membership. UK country was used as a weighting factor in the regression.

RRR (CI_{95}) = Relative risk ratio with 95% confidence interval (between brackets). *Z* = *Z*-based statistic for Wald's test.

[1] Taken from the Organisation for Economic Co-operation and Development.

[2] Data collected from the respondent parent.

[3] Measured using the Kessler Screening Scale for Psychological Distress (K6).

[4] The Development index was calculated by summing up the ratings of the Denver Developmental Screening test and the MacArthur Communicative Development Inventories.

[5] Measured using the Child-Parent Relationship Pianta Scale (Short Form).

* $p < .05$; ** $p < .01$.